US008018136B2

(12) **United States Patent**
Gingrich, III et al.

(10) **Patent No.: US 8,018,136 B2**
(45) **Date of Patent: Sep. 13, 2011**

(54) **INTEGRATED LED DRIVER FOR LED SOCKET**

(75) Inventors: **Charles Raymond Gingrich, III**, Mechanicsburg, PA (US); **Christopher George Daily**, Harrisburg, PA (US)

(73) Assignee: **Tyco Electronics Corporation**, Berwyn, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 281 days.

(21) Appl. No.: **12/372,823**

(22) Filed: **Feb. 18, 2009**

(65) **Prior Publication Data**

US 2009/0218923 A1 Sep. 3, 2009

Related U.S. Application Data

(60) Provisional application No. 61/032,317, filed on Feb. 28, 2008.

(51) **Int. Cl.**
H01L 33/00 (2010.01)
F21V 19/00 (2006.01)
F21V 29/00 (2006.01)

(52) **U.S. Cl.** **313/498**; 313/512; 313/46; 362/249.02; 362/373; 257/712

(58) **Field of Classification Search** 313/512
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,150,774	A	11/2000	Mueller et al.	
6,764,345	B1 *	7/2004	Duesterhoeft et al.	439/637
6,787,999	B2 *	9/2004	Stimac et al.	315/51
7,806,575	B2 *	10/2010	Willwohl et al.	362/547
2006/0002125	A1 *	1/2006	Kim et al.	362/509
2007/0070645	A1 *	3/2007	Coushaine et al.	362/555
2007/0279921	A1 *	12/2007	Alexander et al.	362/368
2008/0025028	A1	1/2008	Gloisten et al.	

FOREIGN PATENT DOCUMENTS

EP	382038	A1 *	8/1990
WO	WO 2005/025935		3/2005

OTHER PUBLICATIONS

PCT International Search Report; International Application No. PCT/US2009/001222; International Filing Date Feb. 26, 2009.

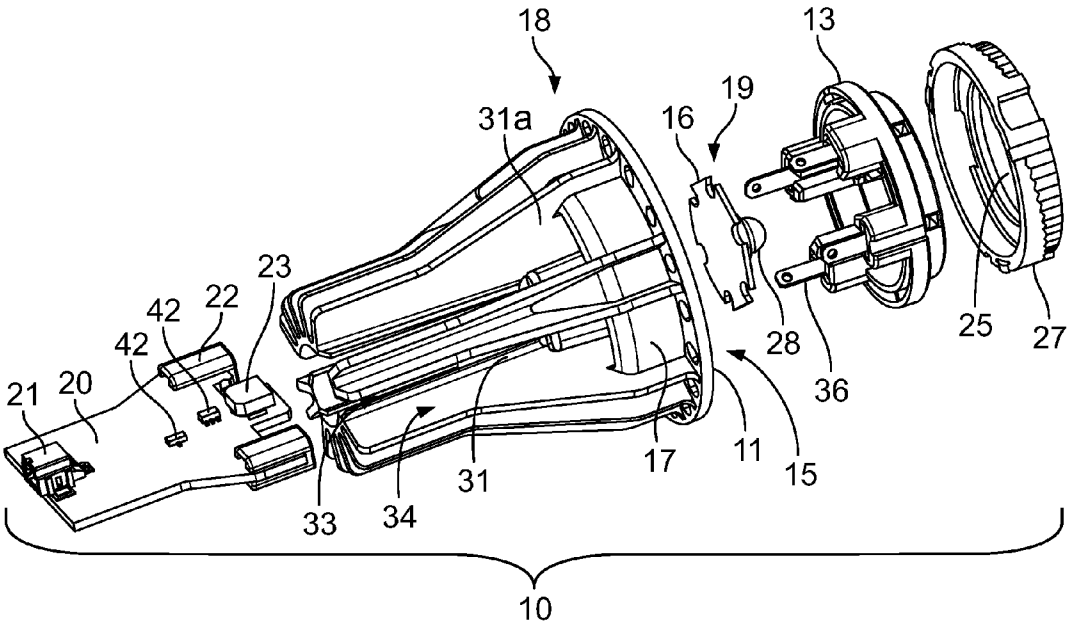
* cited by examiner

Primary Examiner — Sikha Roy

(57) **ABSTRACT**

A mounting assembly for supporting an LED in a lighting fixture. A first substrate containing the LED has contact pads in electrical communication with the LED. A contact carrier has a plurality of contacts that correspond with the contact pads of the first substrate. A second substrate has electronic components to power the LED. A first contact arrangement on the second substrate engages the integral electrical contact portions of the contact carrier, and a second contact arrangement provides external connections to the electronic components. A heat sink portion is engaged in thermal contact with the contact carrier and the first substrate. The heat sink portion includes finned members for dissipation of heat generated by the LED disposed within the heat sink portion. A slot is provided in the heat sink projecting axially of the heat sink portion, for receiving and securing the second substrate.

18 Claims, 4 Drawing Sheets



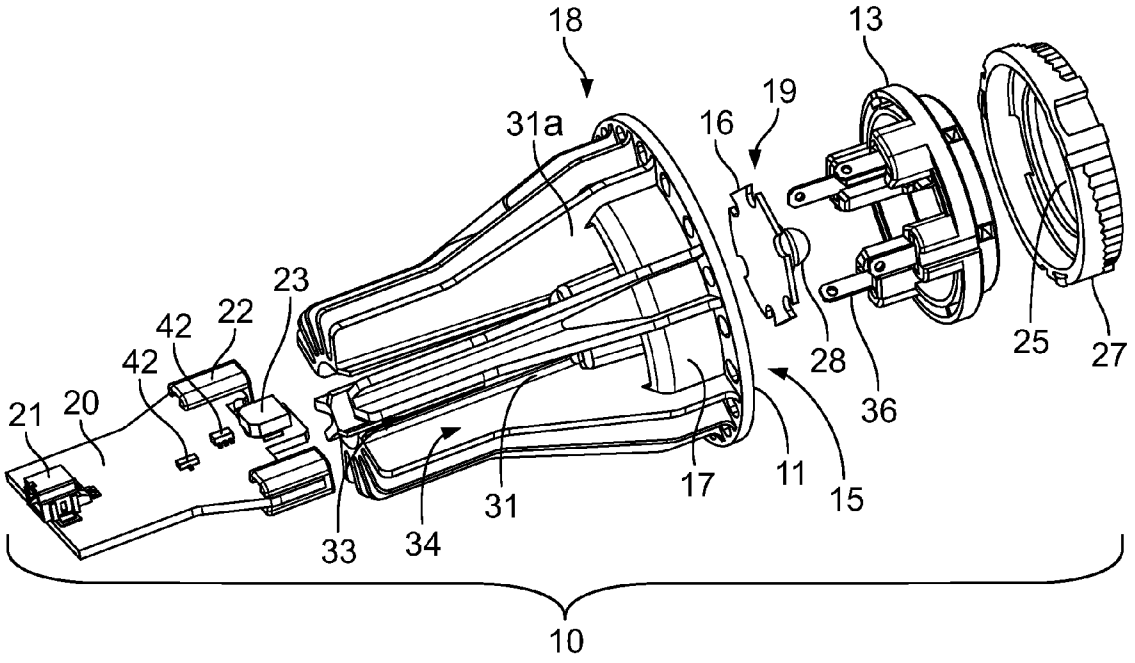

18
13
19
31a
16
23
42
22
42
28
25
27
21
20
36
17
11
15
31
33
34
10

FIG. 1

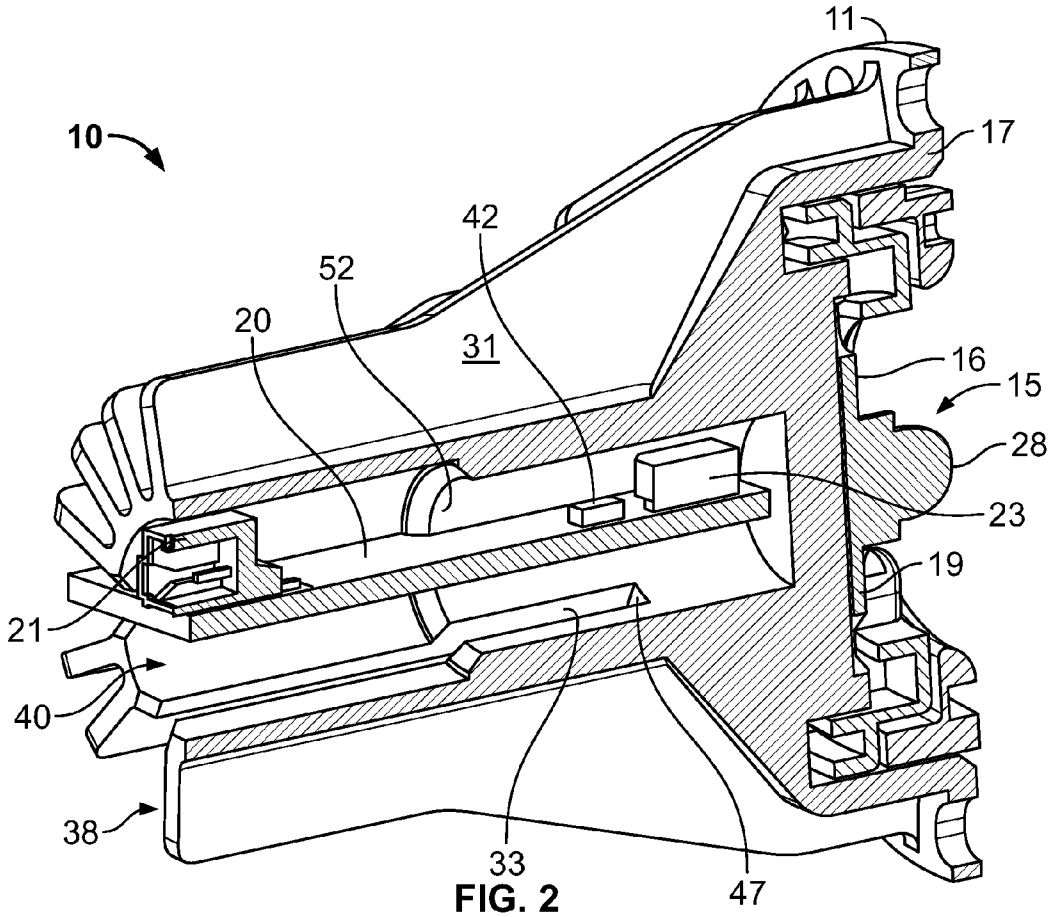

11
10
17
42
52
20
31
16
15
28
23
19
21
40
38
33
47

FIG. 2

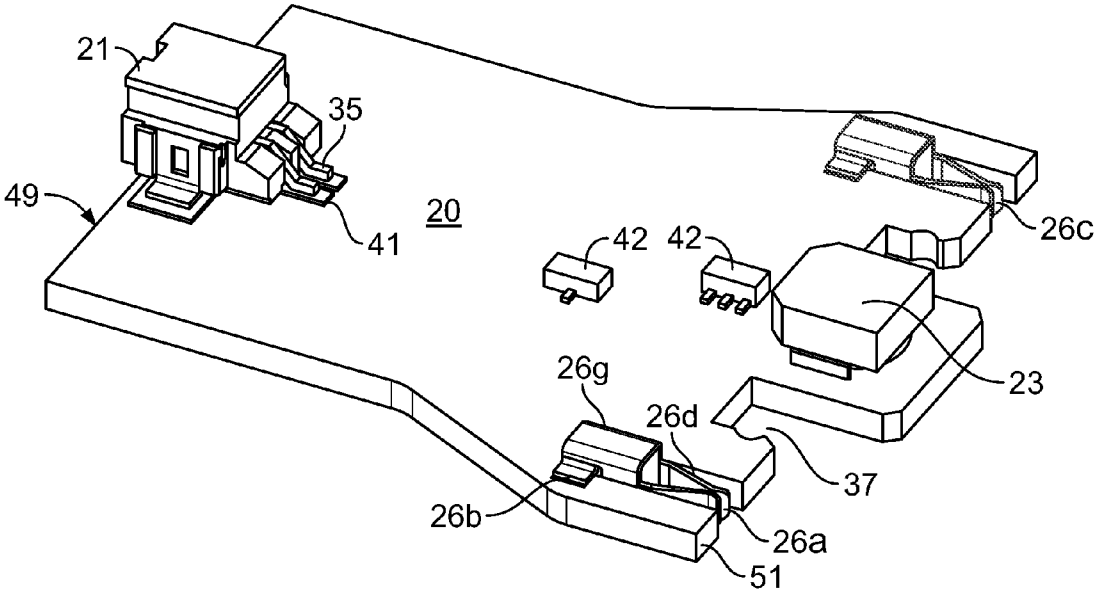


FIG. 3

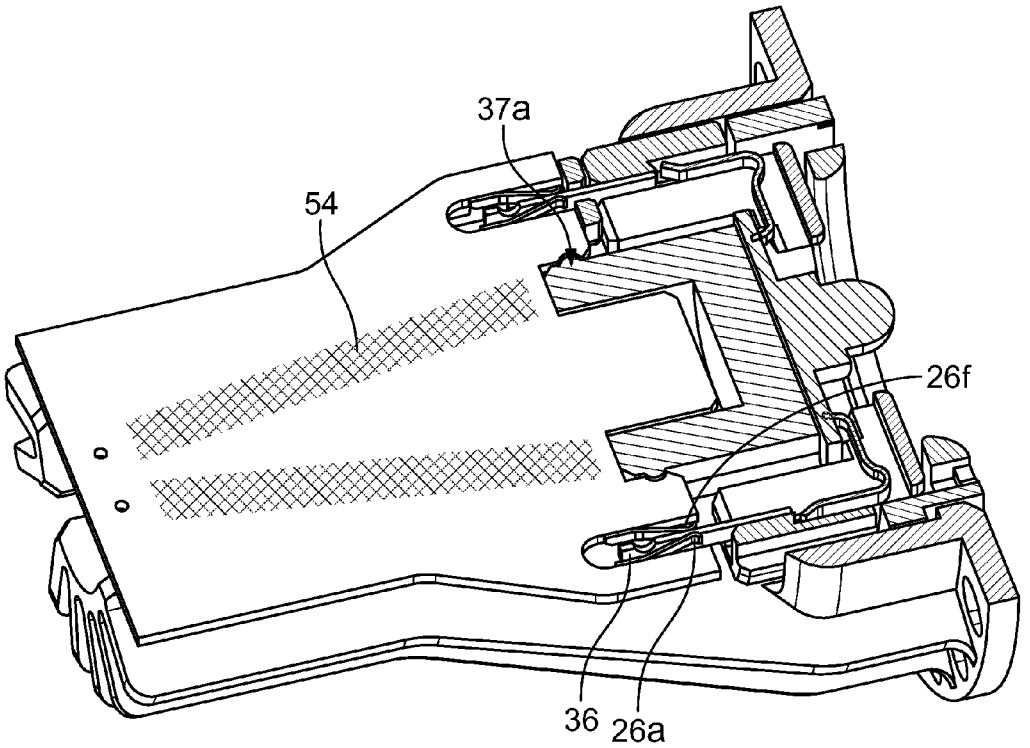


FIG. 4

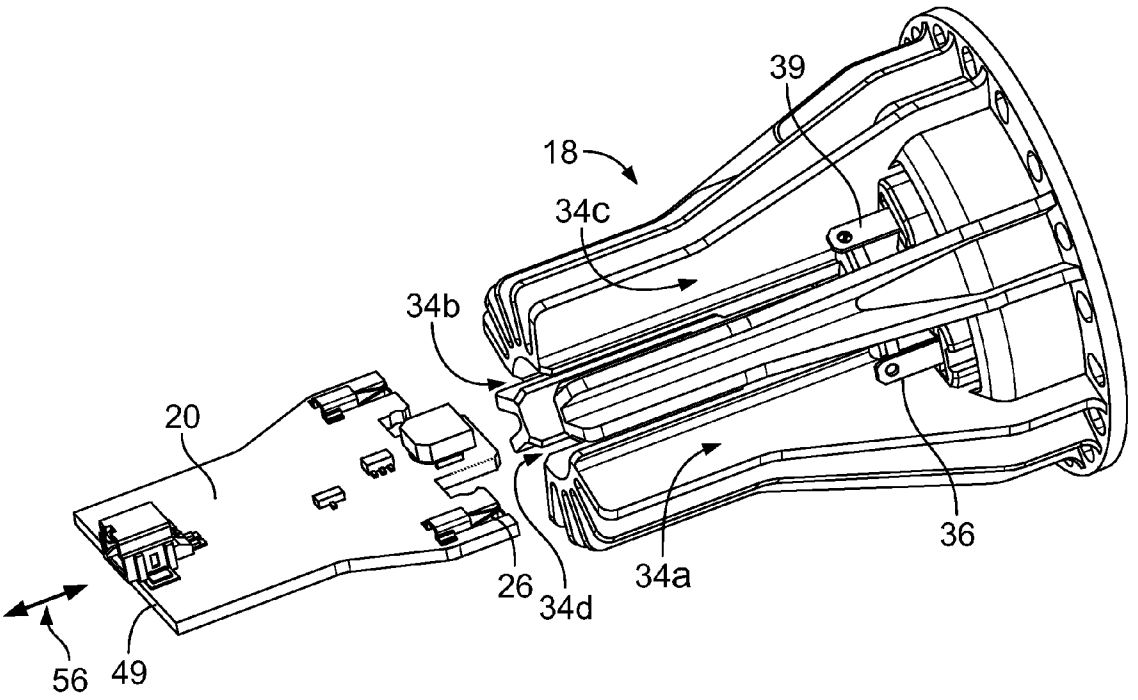


FIG. 5

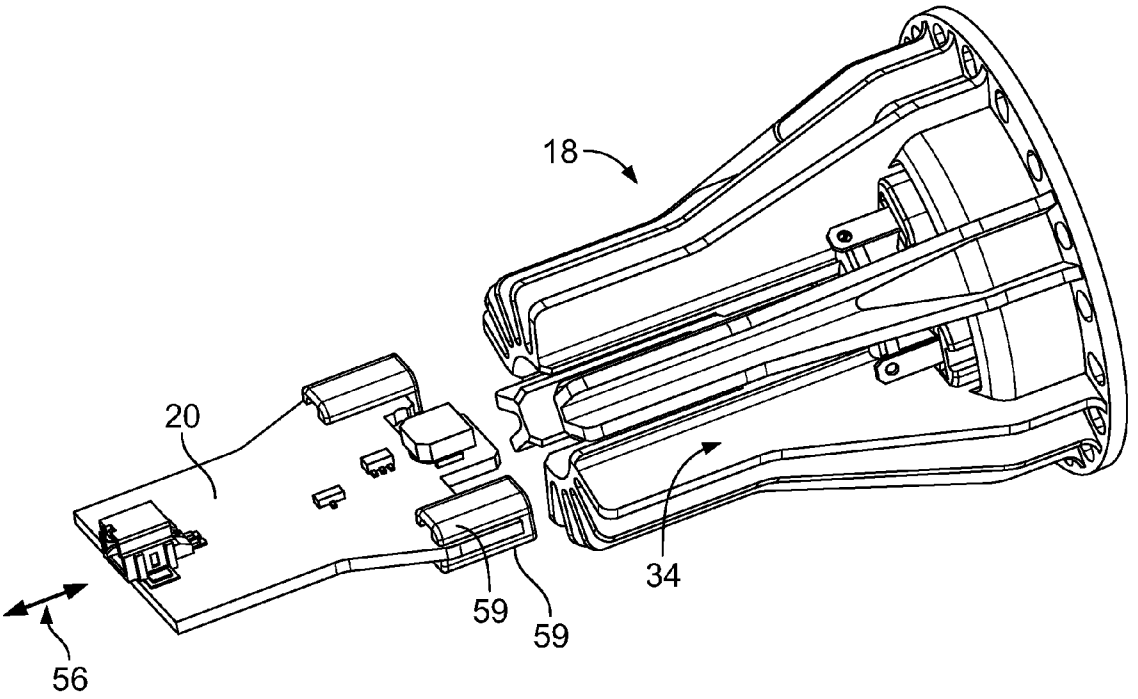


FIG. 6

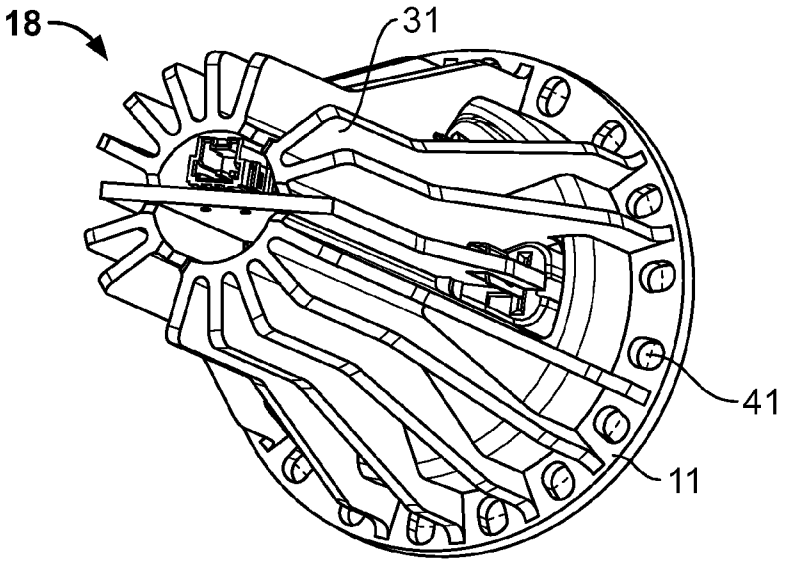


FIG. 7

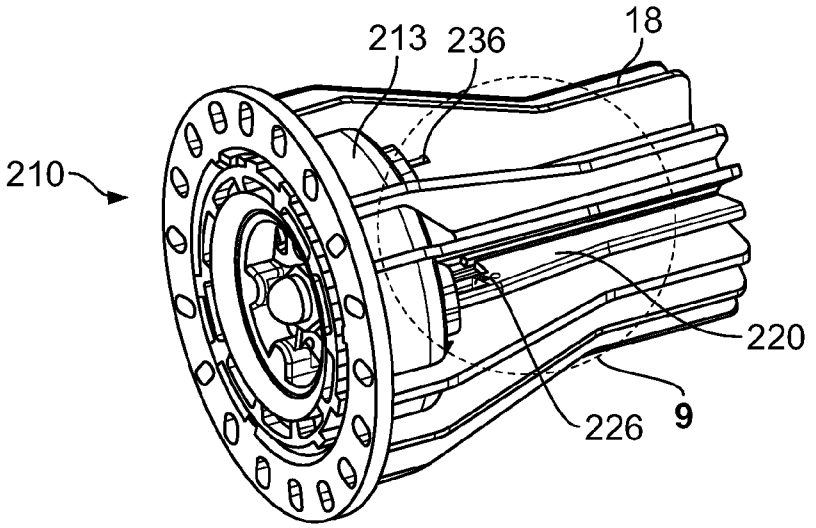


FIG. 8

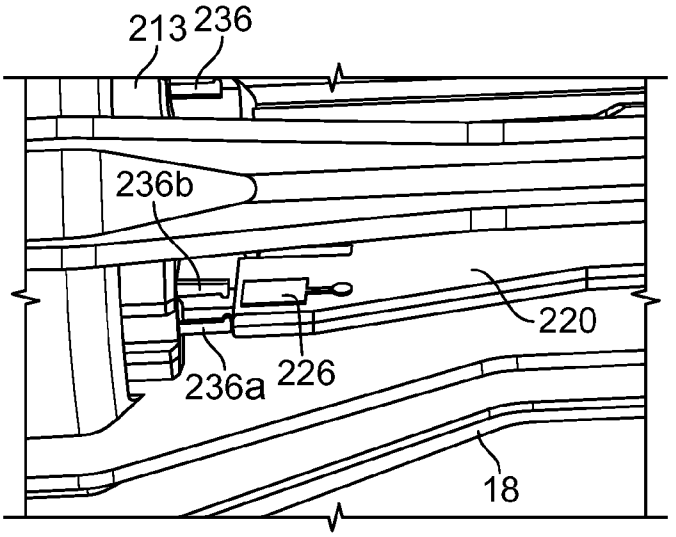


FIG. 9

INTEGRATED LED DRIVER FOR LED SOCKET

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 61/032,317 entitled INTEGRATED LED DRIVER FOR LED SOCKET filed Feb. 28, 2008.

FIELD OF THE INVENTION

The present invention is directed to electronic components, and more particularly to a universal socket assembly having an integral driver assembly for light emitting diodes (LEDs).

BACKGROUND OF THE INVENTION

High intensity LEDs may be used for general-purpose illumination, and in specialty lighting applications such as architectural and video display applications. Some manufacturers design LED lighting assemblies that are customized for specific devices.

Since LEDs are current driven devices, most LEDs require a constant source of current to properly operate. A separate LED driver assembly is required to regulate a constant current to the LED. The LED driver assembly is a separate unit, which is mounted on the lighting fixture remote from the LED and then wired to the remote LED. The labor and hardware that are required for mounting and wiring an LED driver assembly can be a disadvantage in the manufacturing and installation of the LED lighting fixture. The labor and hardware required for mounting and wiring the fixture may also present an obstacle when designing an elegant, stream lined lighting fixture that incorporates the LED.

What is needed is a driver assembly that attaches integrally to a standard LED lighting socket, or LED pixel holder, for high-intensity LEDs, which driver assembly integrates electrical and thermal connections in a single receptacle. Other features and advantages will be made apparent from the present specification. The teachings disclosed extend to those embodiments that fall within the scope of the claims, regardless of whether they accomplish one or more of the aforementioned needs.

SUMMARY OF THE INVENTION

In one embodiment, the present invention is directed to an LED mounting assembly for a lighting fixture including a first substrate including one or more LEDs mounted thereon, and a plurality of contact pads in electrical communication with the LED. A contact carrier includes a plurality of integral electrical contact portions arranged about a perimeter of the contact carrier. The plurality of integral electrical contact portions correspond with the plurality of electrical contact pads of the first substrate. A second substrate includes electronic components configured to power the LED. The second substrate includes a first contact arrangement that engages the integral electrical contact portions of the contact carrier, and a second contact arrangement to engage external connections to the electronic components. A heat sink portion is retentively engageable in thermal communication with the contact carrier and the first substrate.

Additional embodiments are contemplated within the scope of the following detailed specification.

An advantage of the present invention is a printed circuit (PC) board assembly with a constant current driver circuit that is integrated directly into an LED pixel assembly.

Another advantage is a PC driver board that can be easily, quickly and integrally assembled into an LED pixel assembly, and does not require a solder or thermal adhesive connection to the LED pixel assembly.

Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded view of an exemplary LED socket and integral LED driver.

FIG. **2** is a cross-sectional view through the center of the LED socket taken perpendicular to the integral driver board of FIG. **1**.

FIG. **3** is a perspective view of the LED driver card of FIG. **1**.

FIG. **4** is a cross-sectional view through the center of the LED socket and LED driver card in FIG. **1**.

FIG. **5** is a view of one embodiment showing the LED driver card being inserted into the LED socket.

FIG. **6** is an alternate embodiment showing the LED driver card being inserted into the LED socket.

FIG. **7** is a perspective view of an exemplary assembled LED socket including the integral driver.

FIG. **8** is perspective view of an alternate embodiment having an LED driver card with an edge connector.

FIG. **9** is an enlarged sectional view of the area designated in FIG. **8** by a broken line **9**.

DETAILED DESCRIPTION OF THE INVENTION

Commonly assigned U.S. patent application Ser. No. 11/742,611, filed May 1, 2007, discloses an exemplary mounting assembly for supporting high intensity LEDs in a lighting fixture, for use with the integrated driver socket, and the same is hereby incorporated by reference in its entirety.

Referring to FIG. **1** and FIG. **7**, an exemplary embodiment of an LED connector assembly **10** has a heat sink **18** with a fluted or finned body that provides additional surface area for dissipating heat. Heat sink **18** is designed with a complementary outer ring **11**, similar to conventional halogen bulbs, e.g., types GU10 or MR16 standard bulbs, which have outer rings on the reflector assembly that permit the LED connector assembly **10** to be interchangeable with conventional bulbs. In another embodiment, a threaded rear portion (not shown) of heat sink **18** may be provided that threads into a threaded lighting fixture (not shown). An LED **28** is mounted on a printed circuit board (PCB) substrate or assembly **16**. LED PCB assembly **16** rests within a cavity **15** configured to receive LED PCB assembly **16**. Cavity **15** is defined by a circumferential wall **17** disposed at one end of individual fin portions **31** projecting radially inward from the outer radius of heat sink **18**. Contacts **36** are inserted into a contact carrier **13**. Contacts **36** extend into channels **33** defined by fin portions **31**. Fin portions **31** dissipate radiant heat to the ambient air circulating in the spaces or channels **34** defined by adjacent fin portions **31**.

The number of contacts **19** of LED PCB assembly **16** depends on the number of LEDs **28** that are mounted on LED PCB assembly **16**. An LED PCB assembly **16** includes two contact pads **19** for an LED PCB assembly **16** with a single

LED **28**, and an LED PCB **16** assembly containing three LEDs **28** includes four contact pads **19**, although various LED interconnections may be used. E.g., red, green, blue (RGB) LEDs include three LEDs, which share a common anode connection, such that four contact pads **19** are sufficient to power the three LEDs. The number of contacts **36** shown in the drawings is exemplary only, and is not intended to limit the scope of the invention. Contact carrier **13** may be inserted into a cavity **15** disposed at one end of heat sink **18**. Contact carrier **13** fits into cavity **15** and makes thermal contact against LED PCB assembly **16** to maintain LED PCB assembly **16** in position within cavity **15**. A locking ring **27** fits over contact carrier **13** and ratchets into place under a flange portion **11** to secure contact carrier **13** and an optional transparent lens (not shown). Locking ring **27** has an aperture **25** to allow light penetration. LED PCB assembly **16** is secured in position by the locking ring. Locking ring **27** urges contacts **36** against contact pads **19** for positive electrical contact and urges LED PCB assembly **16** into thermal contact with heat sink **18**. Contact carrier **13** includes contacts **36** for mating with LED PCB contact pads **19**. LED PCB **16** is maintained by locking ring **27** in thermal contact or communication with heat sink **18**.

Referring next to FIGS. **2** and **3**, channels **34***a*-**34***d* (See, e.g., FIG. **5**) extend along an axial core aperture **40** from a distal end **38** of heat sink **18**, in the direction of flange portion **11**. An LED driver card **20** is inserted into guide slots **33** on opposite sides of axial core aperture **40**. Guide slots **33** are configured to receive LED driver card **20**. A pair of mating slots **37** are provided in LED driver card **20**. Mating slots **37** correspond with end walls **47** in guide slots **33** to limit the travel of LED driver card **20** in guide slots **33** and position LED driver card **20** for receiving contacts **36** in receptacle portions **26**, located adjacent to mating slots **37**. Retention of LED driver card **20** is achieved by engagement of recesses **37***a* with corresponding detent ridges located on heat sink **18**. (See, e.g., FIG. **4**)

LED driver card **20** includes integrated circuits (not shown), which regulate various electrical and electronic parameters such as constant current and voltage applied to LED PCB **16**. An external connector **21** is positioned adjacent a rear edge **49** of LED driver card **20**. Receptacle portions **26** are positioned adjacent an opposite edge **51** of LED driver card **20**. External connector **21** includes leads **35** that connect to printed circuit pads **41**, e.g., by soldering, for interconnecting an external power source to internal trace conductors of LED driver card **20**. External connector **21** may be a CT (common terminal) connector, such as manufactured by Tyco Electronics Co. of Middletown, Pa., or any suitable PCB connector. Electronic components commonly referred to in the electronics industry as surface mounted technology (SMT) components **23**, **42** are mounted on LED driver card **20**. SMT components **23**, **42**, contain driver integrated circuits and passive electronic components for powering and controlling LED PCB **16**. SMT components **42**, **23**, fit inside the core aperture with sufficient clearance to avoid interference from an inner wall **52** when LED driver card **20** is inserted therein.

Receptacle portions **26** include spring arms **26***a* at the leading edge for receiving contacts **36**. Spring arms **26***a* have opposing leaf portions **26***d* that converge inwardly to a contact region **26***f* (see, e.g., FIG. **4**), and then diverge outwardly at the distal end to form a guide region in which contact **36** enters receptacle portion **26**. A pair of panels **26***b* project laterally from receptacle portion **26** from a hollow frame portion **26***g*. The hollow frame portion **26***g* surrounds contact **36** to constrain movement of contact **36** within hollow frame portion **26***g*, thereby avoiding short circuiting contact **36** to heat sink **18** or to traces or other conductive surfaces on LED driver card **20**. Receptacle portion **26** shown is merely one embodiment, and other connector arrangements, e.g., card edge connectors (FIGS. **8** & **9**) or others, may be used within the scope of the appended claims.

Referring to FIG. **4**, LED driver card **20** includes surface regions **54** which are free of printed circuit traces (not shown) on the surface, as indicated in the drawing by cross-hatching. Surface regions **54** are provided in proximity to the inner wall **52** and LED driver card **20** interface in slot **33**, to prevent possible short circuits between the traces and heat sink **18**.

Referring next to FIG. **5**, LED driver card **20** is shown as it is being inserted in to and/or removed from heat sink **18**, the direction of movement being indicated by arrow **56**. The receptacle portions **26** mate with contacts **36** when using the opposite pair of channels designated as **34***a* and **34***b*. A second pair of channels **34***c*, **34***d* are arranged in alignment with a second set of contacts **39**, at approximately 30° axial rotation from the plane intersecting channels **34***a*, **34***b*. LED driver card **20** may be selectively inserted in either pair of channels **34***a*, **34***b*, or **34***c*, **34***d*, e.g., where two different color LEDs are provided on LED PCB **16**. Alternatively, contacts **36**, **39** and associated channels **34***a*-**34***d* may be configured with rejection features to accept different style boards for driving different components on LED PCB **16**. The two positions associated with channel pairs **34***a*, **34***b* and **34***c*, **34***d*, allow for flexibility to connect to different pad configurations on LED PCB **16**.

Referring next to FIG. **6**, an alternate embodiment of LED driver card **20** is shown. The embodiment of FIG. **6** is similar to that of FIG. **5**, wherein LED driver card **20** includes an alternative receptacle **26** having an external insulating shell **59** that insulates receptacle **26** from electrical contact with heat sink **18**. The insertion movement indicated by arrow **56** and channels **34** operate in the same manner as described above with respect to FIG. **5**.

Referring next to FIGS. **8** and **9**, in an alternate embodiment an LED driver card **220** and a contact carrier **213** are connected by a card edge connector arrangement. An LED driver card **220** includes contact pads **226** on upper and lower sides of LED driver card **220**, which mate with contact **236**. A pair of contact beams **236***a* and **236***b* form a furcated contact **236** that pinches contact pads **226** of LED driver card **220** in a friction fit.

While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

The invention claimed is:

1. An LED connector assembly for a lighting fixture comprising:

a first substrate comprising at least one LED mounted thereon, and a plurality of contact pads in electrical communication with the at least one LED;

a contact carrier comprising a plurality of integral electrical contact portions arranged about a perimeter of the contact carrier, the plurality of integral electrical contact

portions corresponding to the plurality of electrical contact pads of the first substrate;

a second substrate comprising electronic components configured to power the at least one LED, a first contact arrangement configured to engage the integral electrical contact portions of the contact carrier, and a second contact arrangement for external connections to the electronic components; and

a heat sink portion retentively engageable in thermal communication with the carrier and the first substrates

wherein the heat sink further comprises:

a first pair of channels to direct the second substrate into electrical communication with a first pair of contact portions of the plurality of integral electrical contact portions; and

a second pair of channels to direct the second substrate into electrical communication with a second pair of contact portions of the plurality of integral electrical contact portions; and

wherein the first pair of channels is offset from the second pair of channels approximately 30° axial rotation, and the second substrate is selectively insertable in either of the first pair of channels or the second pair of channels.

2. The assembly of claim **1**, wherein the heat sink portion extends longitudinally from the contact carrier.

3. The assembly of claim **1**, wherein the heat sink comprises a plurality of finned members for dissipation of heat generated by the first substrate.

4. The assembly of claim **3**, wherein the second substrate is an LED driver card, the LED driver card comprising at least one surface region free of printed circuit traces, the at least one surface region disposed adjacent an inner wall of at least one of the finned members, where the LED driver card and the inner wall are adjacent.

5. The assembly of claim **1**, further comprising at least one slot, the at least one slot projecting at least a portion of an axial length of the heat sink portion for integrally receiving the second substrate in electrical communication with the first substrate.

6. The assembly of claim **1**, further comprising a cavity defined by a circumferential wall disposed at one end of the heat sink, the cavity configured to receive the first substrate.

7. The assembly of claim **6**, wherein the contact carrier fits into the cavity in thermal contact against the first substrate to maintain the first substrate within cavity.

8. The assembly of claim **7**, further comprising a locking ring defining an aperture, the locking ring attachable to the contact carrier.

9. The assembly of claim **8**, wherein the first substrate urges the plurality of integral electrical contact portions into electrical contact with the contact pads, and into thermal communication with the heat sink.

10. The assembly of claim **1**, wherein the first pair and the second pair of channels are defined by fin portions configured to dissipate radiant heat.

11. The assembly of claim **1**, wherein the at least one LED comprises three LEDs, each LED having an anode connected in common and an isolated cathode, the first substrate further comprising four contact pads for connecting each LED of the three LEDs to an external circuit.

12. The assembly of claim **1**, wherein the second contact arrangement of the second substrate further comprises an external connector positioned adjacent a first edge of the second substrate, the external connector comprising wire leads connected to printed circuit pads, the external connector configured for interconnecting an external power source to at least one trace conductor etched in the second substrate.

13. The assembly of claim **12**, wherein the second substrate further comprises at least one receptacle portion positioned adjacent a second edge of the second substrate.

14. The assembly of claim **12**, the second substrate further comprising a plurality of surface mounted electronic components configured to power and control the at least one LED.

15. The assembly of claim **14**, wherein the electronic components comprise at least one of a driver integrated circuit and a passive electronic component.

16. The assembly of claim **12**, wherein the second substrate further comprises a plurality of receptacle portions, at least one receptacle portion including a pair of opposing spring arms disposed at a leading edge for receiving at least one of the integral electrical contact portions; the spring arms comprising opposing leaf portions converging to a contact region, and diverging outwardly at a distal end to guide the integral electrical contact portion into the receptacle portion.

17. The assembly of claim **16**, wherein at least one receptacle portion of the plurality of receptacle portions further comprises a frame portion surrounding at least a portion of at least one integral electrical contact portion, the frame portion configured to constrain movement of the integral electrical contact portion within the frame portion.

18. The assembly of claim **1**, wherein the second substrate is connected with the contact carrier by an edge connector, the first contact arrangement comprising an upper contact pad and a lower contact pad disposed on opposite sides of the second substrate, the upper contact pad and a lower contact pad mateable with the plurality of integral electrical contact portions; and the contact carrier further comprising a furcated contact arrangement configured to engage the contact pads of the second substrate.

* * * * *